REMARKS/ARGUMENTS

Examiner Velasquez is thanked for the courteous interview granted with Teddy. S. Gron, on July 2, 2009. Although no agreement as to the allowability of the pending claims was reached during the interview, counsel for Applicant emphasized the distinction between an oxide film "produced by a process comprising oxidizing the Ti-Al alloy" as in Claim 1 and Yao's deposit of titanium oxide on a metal surface from a titanium fluoride solution. Counsel also emphasized that (1) there is no evidence of record that optimization to prevent embrittlement due to oxidation would necessarily result in the claimed titanium alloy material which is formed to resist embrittlement due to hydrogen absorption, and (2) the concentration of Al in Grunke's Al concentration layer for oxidation resistance is much higher than the Al concentration in the Al concentration layer in the claimed alloy and inconsistent with Lampman's teaching to maintain the Al concentration below 7% to increase tensile and creep strength without causing associated embrittlement. Counsel also noted that Miyamoto's alloy is highly oxidation-resistant and further improvement is not suggested. Examiner Velasquez minimally agreed to reconsider the evidence of record.

Previously presented Claims 1, 2, 7-9, 11-13, and 15-18 are pending in the Application. Claim 15 has been withdrawn. No claim has been amended. All pending claims stand finally rejected under 35 U.S.C. 103. The Examiner's withdrawal (Office Action, dated April 10, 2009 (OA), page 2) of all previous objections and rejections of claims under 35 U.S.C. 112, 1st ¶, is appreciated.

The Claimed Invention

Claim 1 is directed to a titanium alloy material comprising at least three layers. A bulk Ti-Al alloy layer comprises an Al concentration of 0.50-3.0 mass%. Covering the bulk Ti-Al alloy layer is an oxide film layer comprising 50% or more of a crystalline oxide and having a thickness of 1.0-100 nm. The oxide film layer is produced by a process comprising

oxidizing the Ti-Al alloy. Between the bulk Ti-Al alloy layer and the oxide film layer, there is formed an Al concentration layer having an Al concentration in a range from 0.8-25 mass% which is at least 0.3 mass% higher than the Al concentration in the bulk Ti-Al alloy layer. The claimed titanium alloy material has superior hydrogen absorption resistance which prevents damaging fractures caused by hydrogen absorption in corrosive environments (Spec., pp. 4-5, Disclosure of the Invention).

Rejection under 35 U.S.C. 103

Claims 1, 2, 6-9, 11-13, and 16-18 stand finally rejected under 35 U.S.C. 103 over Miyamoto (EP 1126 139 A2, published August 22, 2001) in view of Grunke (U.S. Patent 4,936,927, issued Jun 26, 1990), Lampman ("Wrought Titanium and Titanium Alloys," ASM Handbook, Vol. 2, pp. 597-600 (1960)), and Yao (U.S. Patent 6,066,359, issued May 23, 2000)(OA, p. 4). The rejection should be withdrawn for the following reasons.

The Examiner relies on Miyamoto for its description of the bulk Ti-Al alloy layer comprising an Al concentration of 0.50-2.3 mass% and nothing more (OA, p. 3, last ¶). Miyamoto uses its bulk Ti-Al alloy to make automobile mufflers. Miyamoto teaches that its bulk Ti-Al alloy has superior heat-resistance, superior oxidation-resistance, and superior workability (Miyamoto, Abstract and [0008-0009; 0021-0022; 0038-0039]).

The Examiner relies upon Grunke for its description of a Ti-Al alloy having a relatively high concentration of Al near the surface of the alloy which gradually decreases toward the bulk of the alloy (OA, p. 4, 1st ¶). Grunke's application of higher Al concentrations near the surface of the Ti-Al alloy is intended to protect the surface of the alloy "against oxygen embrittlement" (Grunke, col. 3, ll. 1-6), i.e., to prevent the surface of the alloy from taking up oxygen (Grunke, col. 3, ll. 30-34; col. 4, ll. 34-39; col. 1, ll. 23-37) and becoming brittle as a result thereof (Grunke, col. 2, ll. 15-41). In order to provide the high Al concentrations near the surface of a Ti-Al alloy, Grunke applies a first layer of $TiAl_3$

to the surface of the alloy and causes it to diffuse into the alloy by applying heat. The first treatment is followed by the applications of subsequent layers of $TiAl_2$, TiAl, and Ti_3Al, each application followed by annealing (Grunke, col. 3, ll. 49-61). As can be seen from Grunke's Figures 1a, 1b, 2a, 2b, 3a and 3b, the Al concentration is highest nearest to the surface of the Ti-Al alloy.

The Examiner concludes that it would have been obvious to persons having ordinary skill in the art in view of Grunke's teaching "to induce a concentration gradient of aluminum particles in the alloy of Miyamoto . . . because the gradient protects the titanium and avoids sharp changes or discontinuities in the mechanical properties of the alloy (col. 4, ll. 10-15)" (OA, p. 4, 1st ¶). Applicant is confused by the Examiner's explanation for a variety of reasons.

First, Miyamoto teaches that its Ti-Al alloy has superior heat and oxidation resistance. What reasonable incentive would persons having ordinary skill in the art have to improve the oxidation resistance of a Ti-Al alloy which already has superior oxidation resistance. Second, Grunke improves the oxidation resistance of a Ti-Al alloy by increasing the concentration of Al nearest the surface of the Ti-Al alloy. However, that increase is promoted by initially applying $TiAl_3$ to the surface of the alloy, applying heat to diffuse the applied $TiAl_3$ into the Ti-Al alloy surface, and repeating the procedure using $TiAl_2$, TiAl, and Ti_3Al in separate steps. Persons having ordinary skill in the art reasonably would have understood from Grunke's application process and the materials applied that the Al concentration in the protective layer of the Ti-Al alloy should exceed the "range of from 0.8-25 mass%" required for the titanium alloy material of Claim 1, would exceed the "range of 0.8-16mass%" required for the titanium alloy material of Claim 17, definitely would exceed the "range of 0.8-6 mass%" required for the titanium alloy material of Claim 18. Third, the Examiner has not explained why a person having ordinary skill in the art would have applied

a high Al concentration layer to improve the oxidation-resistance of the surface of the Ti-Al alloy and/or to protect the surface of the Ti-Al alloy from oxygen embrittlement and thereafter apply an oxide film produced by oxidizing the Ti-Al alloy in accordance with Applicant's claims. Persons having ordinary skill in the art normally would not apply an oxidation resistant layer to the surface of a Ti-Al alloy and then cover it with an oxide film or subject the surface of a Ti-Al alloy to oxidation to further prevent oxygen embrittlement caused by oxygen. Persons having ordinary skill in the art are presumed to have common sense and act accordingly. *In re Sovish*, 769 F.2d 738, 742-743 (Fed. Cir. 1985); *In re Bozek*, 416 F.2d 1385, 1390 (CCPA 1969).

The Examiner's answer is that persons having ordinary skill in the art would have optimized the Al concentration near the surface of the Ti-Al alloys to otherwise enhance the tensile strength, creep strength, and elastic moduli of Ti-Al alloys in accordance with Lampman's teaching at page 599, third column, "Aluminum" subsection, that Al increases the tensile strength, creep strength, and elastic moduli of titanium alloys (OA, p. 4, 2nd full ¶). However, Lampman also teaches that "the maximum solid solution strengthening that can be achieved by aluminum is limited, because above 6% Al promotes ordering and Ti_3Al (α_2) formation, <u>which is associated with embrittlement</u>" (Lampman, p. 599, col. 3, "Aluminum" subsection; emphasis added). Therefore, Lampman appears to teach away from Grunke's process involving concentrating $TiAl_3$, $TiAl_2$, TiAl, and Ti_3Al near the surface of a Ti-Al alloy when persons having ordinary skill in the art intend to increase the tensile strength, creep strength, and elastic moduli of the alloy because it causes rather than prevents embrittlement. Moreover, if persons having ordinary skill in the art were intent on improving the tensile strength, creep strength, and elastic moduli of a Ti-Al alloy by increasing Al concentration, there would appear to be no reason whatsoever to limit the increase in Al concentration and the improved tensile strength, creep strength, and elastic moduli resulting

therefrom to the layer nearest the surface of the Ti-Al alloy. The Examiner's reasoning defies the common sense for which persons having ordinary skill in the art are recognized.

Moreover, there is no evidence of record which would lead a person having ordinary skill in the art to understand that efforts to optimize variables known to affect embrittlement or degradation caused by oxidation or oxygen absorption would necessarily result in the titanium alloy material Applicant claims. The titanium alloy material Applicant claims is specifically formed to resist embrittlement due to hydrogen absorption in a corrosive environment. Whether the optimization of known variable effective for improving oxidation or oxygen absorption resistance also improves resistance to hydrogen absorption is pure speculation. Speculation should never form the basis for denying patentability. *In re Steele*, 305 F.2d 859, 862 (CCPA 1962).

Next, the Examiner argues that, in view of Yao's disclosure, it would have been obvious to persons having ordinary skill in the art to further cover Miyamoto's heat-resistant, oxidation-resistant Ti-Al alloy, seemingly having Grunke's increased Al concentration layer near its surface to protect against oxygen embrittlement caused by oxidation, with a <u>titanium oxide film</u> for oxidation corrosion resistance (OA, p. 5, 1st ¶). Rather, persons having ordinary skill in the art likely would have expected that Miyamoto's Ti-Al alloy with Grunke's protective layer thereon would be sufficiently resistant to oxygen and oxidative corrosion. Nevertheless, the Examiner argues that persons having ordinary skill in the art would want to cover the high Al concentration layer applied to further protect an already oxidation-resistant Ti-Al alloy surface from oxygen or oxidation corrosion using an oxide film produced by a process comprising oxidation (Yao, col. 5, ll. 1-6). Applicant can only imagine the confusion persons having ordinary skill in the art would face trying to combine the teachings of the prior art disclosures.

Persons having ordinary skill in the art reasonably would not seek to apply an oxide film by a process comprising oxidizing Ti-Al alloy to an oxidation-resistant bulk Ti-Al alloy covered with another layer further resistant to oxygen in order to prevent oxidation corrosion. Moreover, there is a basic distinction between the claimed oxide film "produced by a process comprising oxidizing the Ti-Al alloy" as required by Applicant's Claim 1 and Yao's deposit of titanium oxide on a metal surface. Yao's titanium oxide layer is not, and does not reasonably appear to be the same or even substantially the same as an oxide film "produced by a process comprising oxidizing the Ti-Al alloy" (Claim 1). In this case, the product-by-process limitation does indeed further limit the claimed subject matter. Contrary to the Examiner's finding, an oxide film produced by oxidizing a Ti-Al alloy is not titanium oxide. Rather, it is an oxidized mixture of Ti and Al in the form of a Ti-Al alloy minimally comprising 0.50 - 3.0 mass% of Al, Ti, and unavoidable impurities. The claim language itself makes the distinction. Yao's produces a titanium oxide layer on a metal substrate by soaking the substrate in an aqueous solution of a titanium fluoro complex in the presence of a fluoride ion capturing agent "to form a titanium oxide thin film on the surface of the substrate" (Yao, Abstract). A titanium oxide film so formed in not an oxide film "produced by a process comprising oxidizing the Ti-Al alloy" as Applicant's claims require.

Regarding previously presented Claim 8, the Examiner has not explained why a titanium alloy material in contact with a steel member does not further limit the titanium alloy material. One material in contact with any other chemical or physical material further limits the one material.

The PTO has not shown that the combined prior art teaching would have reasonably suggested the titanium alloy material Applicant claims with reasonable expectation of success. The Examiner's argument that persons having ordinary skill in the art would have optimized recognized result effective variables to make and use the invention Applicant

claims raises too many unanswered questions to support the Examiner's case for obviousness. Why would the skilled artisan be moved to optimize oxidation-resistance when the prior art reasonably suggests that superior oxidation resistance has been achieved? Why would the skilled artisan oxidize a Ti-Al layer to prevent corrosive oxidation? Why would skilled artisans optimize the increase in Al concentration on the surface of a Ti alloy to improve tensile strength, creep strength, and elastic moduli when increased Al concentrations are associated with embrittlement? Why would skilled artisans seek to improve the tensile strength, creep strength, and elastic moduli on one surface of a Ti-Al alloy? The answer to each question is apparent. The person having ordinary skill in the art would not have sought to do so. The Examiner's final rejections are unreasonable and should not be maintained.

A holding of obviousness requires a reasonable suggestion to make and use the subject matter claimed with reasonable expectation of success. *In re O'Farrell*, 853 F.2d 894, 903-904 (Fed. Cir. 1988). In this case, the basis for the Examiner's final rejection is seriously strained.

For the reasons stated herein, Applicant's claims are allowable over the applied prior art and in condition for allowance. Early notice of allowance is respectfully requested.

Respectfully submitted,

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